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Analysis of influence of meteorological factors on air pollution in Hunan Province

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Abstract

With the our country economy level of development and progress continuously, the serious destruction of ecological environment of our country, especially when the air pollution is more serious, so our government relevant departments in order to better improve the ecological environment, atmospheric environment, by adopt the method of air quality monitoring to understand local atmospheric pollution. In this paper, the variation trend of air quality in Hunan province in recent one year was analyzed and studied, including whether the concentrations of carbon monoxide, sulfur dioxide and nitrogen dioxide in the air were kept in the second-level standard, and whether the variables affecting air ozone concentration were related to the duration of sunshine and temperature, etc.

Keywords

Meteorological factors in Hunan Province; Air pollution; Impact

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1. Introduction

Since reform and opening up, the sharp rise in our country's economic level, the resulting environmental pollution problem to be reckoned with, especially in recent years, water pollution, light pollution, soil pollution, air pollution, ecological environment problems are like bamboo shoots after after appeared in public view, the ecological environment problem not only affects the economic development of our country, It also affects the health of the nation. Therefore, our country's environmental protection department of public health in order to better control, prevention and control of environmental pollution to the impact of national, through analyzing the detailed study of air pollution, research professionals will affect atmospheric pollution factors can be divided into natural factors and human factors, and natural factors mainly include: elevation, topography, vegetation coverage, local meteorological conditions, etc. Human factors mainly include urban development, industrial development, agricultural activities, land use and other environmental damage. Especially, in some heavily polluted areas, the local ozone index is too high, PM2.5 value exceeds the limit and so on will affect the health of the local residents. In the process of analyzing and studying the local air pollution, researchers mainly detect air pollutants by using the local average temperature, average precipitation and local air quality index.[1] According to the weather researchers unremitting investigation can be found that: the average temperature, average wind speed have an impact on PM2.5 pollutant concentration, and the average pressure, degree of relief, sunshine time and average wind speed have an influence on the local ozone concentration, thus it can be seen that meteorological factors will directly affect the local atmospheric pollution. Taking Hunan Province as an example, this paper conducts detailed analysis and research on the air pollution situation of various cities and towns in Hunan Province. The specific analysis and research contents are as follows[2]:

2. Data and research methods

2.1. Survey Data

In 2021, the total number of days of heavy pollution in county-level cities and towns in the province will be 48 (one of which will be severe pollution days, occurring in western Hunan). In terms of the time period of heavy pollution, it mainly occurred in January, February and December, with 22 days in January, 11 days in February and 15 days in December. Heavier contamination area, frequency is higher in heavy pollution area is mainly in southern hunan, and hunan area, governed by the hengyang county towns have nine days, followed by the changsha area 7 days, 6 days in yongzhou, 5 days in xiangtan, zhuzhou, yueyang and chenzhou 4 days each, xiangxi area 3 days, loudi and which areas each 2 days, shaoyang and zhangjiajie in the 1 day; See Figure 1[3].

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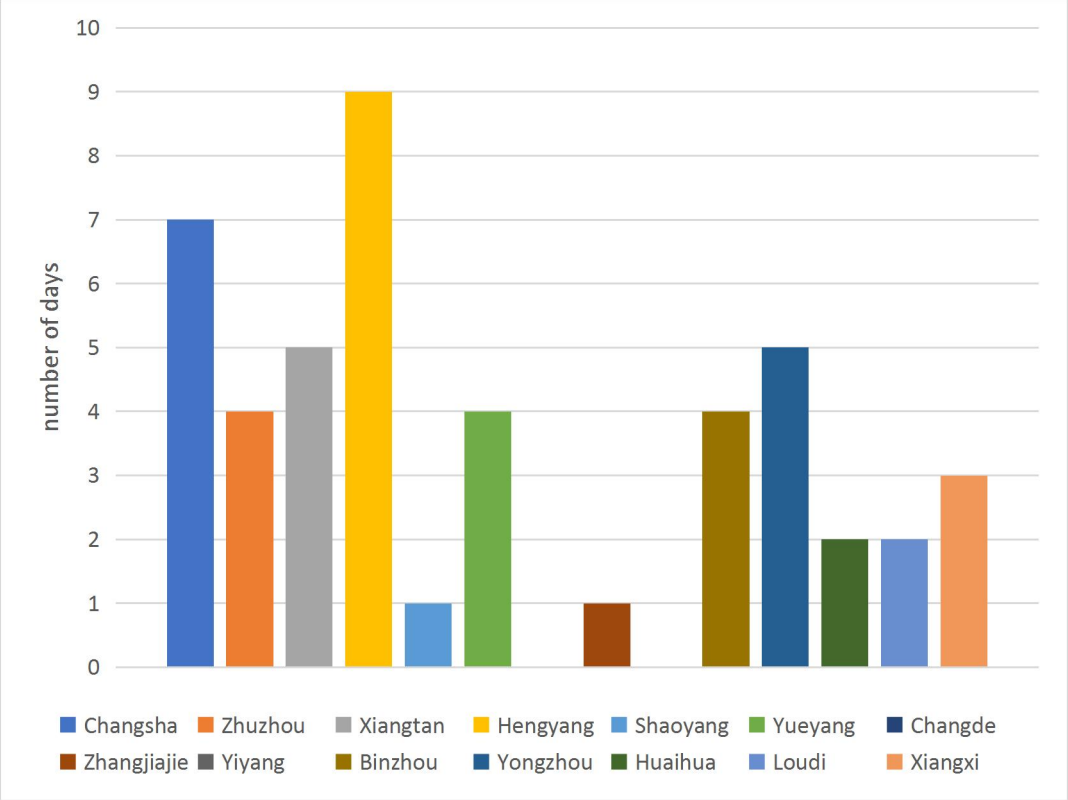

Fig. 1 Distribution of heavy pollution weather days in counties and cities in 2021

2.2. Research Methods

In this paper, correlation analysis technology and stepstep regression analysis technology are used to analyze and study the summarized and sorted data information. In the research process, SPSS20.00 technology is used to assist scientific researchers, and finally EVIWES8.0 technology is used to complete the final data. After the data is calculated, the researchers use EXCEL2013 software to draw the obtained data into tables for easy reference in the future[4].

3. Results and analysis

3.1. The results

In 2021, the comprehensive index of ambient air in 90 county-level cities and towns was 2.96, ranging from 2.00 to 4.17. The overall pollution of 90 county-level towns in the province is relatively low, and the pollution of central and northern Hunan is relatively high. Fine particulate matter and ozone are the biggest single pollutants affecting air quality in county towns.

Guidong, Yanling, Tongdao, Chengbu, Jiangyong, Hongjiang, Mayyang, Rucheng, Xupu, Anhua are the top 10 cities and towns in the list (ranking 1st to 10th). The last 10 (from 90th to 80th) are xinhua county, Lengshuijiang City, Xiangtan County, Huayuan County, Linxiang City, Wangcheng District (linxiang city and Wangcheng District tied for 85th place), Lianyuan City, Changsha County, Xiangxiang City and Longhui County.

The main pollutants affecting air quality in county towns are fine particulate matter and ozone.

3.2. Analysis

According to the comprehensive index of ambient air quality, the ranking of ambient air quality of county-level cities and towns under the jurisdiction of each city (prefecture) from

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good to bad is Huaihua, Chenzhou, Yiyang (chenzhou and Yiyang are parallel), Yongzhou, Zhangjiajie, Zhuzhou, Xiangxi, Changde, Shaoyang, Hengyang, Yueyang, Changsha, Xiangtan, Loudi. Except for Xiangxi, Loudi and Zhangjiajie, the air quality index of the county-level cities under the jurisdiction of the other 11 cities (prefects) is lower than the urban comprehensive index. See Table 3 for details.

Table 3 Statistics of the comprehensive environmental air quality index of county-level cities and towns in The province in 2021

The serial number	city	Comprehensive index of county towns under the jurisdiction	Urban Composite index	Urban comparison
1	Changsha	3.34	3.99	-0.65
2	Zhuzhou	2.80	3.90	-1.10
3	Xiangtan	3.42	4.04	-0.62
4	Hengyang	3.12	3.58	-0.46
5	Shaoyang	3.02	3.66	-0.64
6	Yueyagn	3.19	3.73	-0.54
7	Changde	2.94	3.65	-0.71
8	Zhangjiajie	2.79	2.69	0.10
9	Yiyang	2.76	3.57	-0.81
10	Binzhou	2.76	3.11	-0.35
11	Yongzhou	2.77	3.26	-0.49
12	Huaihua	2.57	3.00	-0.43
13	Loudi	3.80	3.63	0.17
14	Xiangxi	2.89	2.63	0.26

It can be seen from the above measured values of 11 cities in Hunan Province that the air pollution in cities is obviously worse than that in urban areas, especially in the three months of July, August and September, when the air pollution in cities can reach mild pollution, while in the three months of October, November and December, urban air pollution can reach moderate pollution. It can be seen from these data that the colder the weather is, the more serious the local pollution is. Local government departments should pay attention to mild and moderate pollution and timely adjust the focus of concentration control work.

3.3. Analysis of the impact of meteorological factors on air quality

Researchers in hunan province may affect the meteorological factors for analysis and research, and through the false try, the meteorological factors set as independent variables, and ozone, PM2.5 concentration as a dependent variable, through the change of meteorological factors, observe the change of ozone, PM2.5 concentration value, and draw key conclusions. Researchers in air quality numerical case detection process and PM2.5 concentrations of ozone in the air, also can through to the average temperature in hunan, the average pressure, sunshine duration and reference to research on the environmental factors such as the average humidity, can be found when the temperature is higher, the local so local pressure is lower, both in a negative state, There is an obvious linear relationship between air temperature and air pressure. So researchers can start by looking at the linear relationship between ozone and PM2.5 levels and weather[5].

It is found that when average temperature and sunshine time increase, ozone concentration will increase, which is a positive influence relationship, while when average wind speed,

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average atmospheric pressure and average relative humidity increase, ozone concentration will decrease, which is a negative influence relationship. Similarly, by testing the concentration that may affect PM2.5, researchers can find that when average air pressure increases, PM2.5 will increase, which is a positive influence relationship, while when average temperature, sunshine duration and average relative humidity increase, PM2.5 concentration will decrease, which is a negative influence relationship. It can be seen that average air temperature and average air pressure have a certain opposite effect on the ozone concentration and PM2.5 value in the air. If you want to reduce THE PM2.5 value, it will increase the ozone concentration. Air detection personnel found in the experiment that if you want to reduce the ozone concentration and PM2.5 value in the air of Hunan Province, Can increase the humidity in the air through appropriate, have obvious effect.

4. Concentration of main pollutants in urban air

In 2021, according to the Environmental Air Quality Standard (GB 3095-2012), the results show that the annual average concentration of sulfur dioxide, nitrogen dioxide and inhalable particulate matter in the ambient air of county-level cities and towns in the province is 8 micrograms/cubic meter, 14 micrograms/cubic meter and 45 micrograms/cubic meter respectively. The average daily concentration of carbon monoxide at the 95th percentile was 1.2 mg/m3, the average daily maximum 8-hour average concentration of ozone at the 90th percentile was 114 μ g/m3, and the average annual concentration of fine particulate matter was 29 μ g/m3, all reaching the national level 2 concentration.

Degree standard limit value. The maximum 8-hour mean concentration limit of ozone reference day was evaluated, and the 24-hour mean concentration limit of carbon monoxide reference day was evaluated. See Figure 3 for details[5.6]:

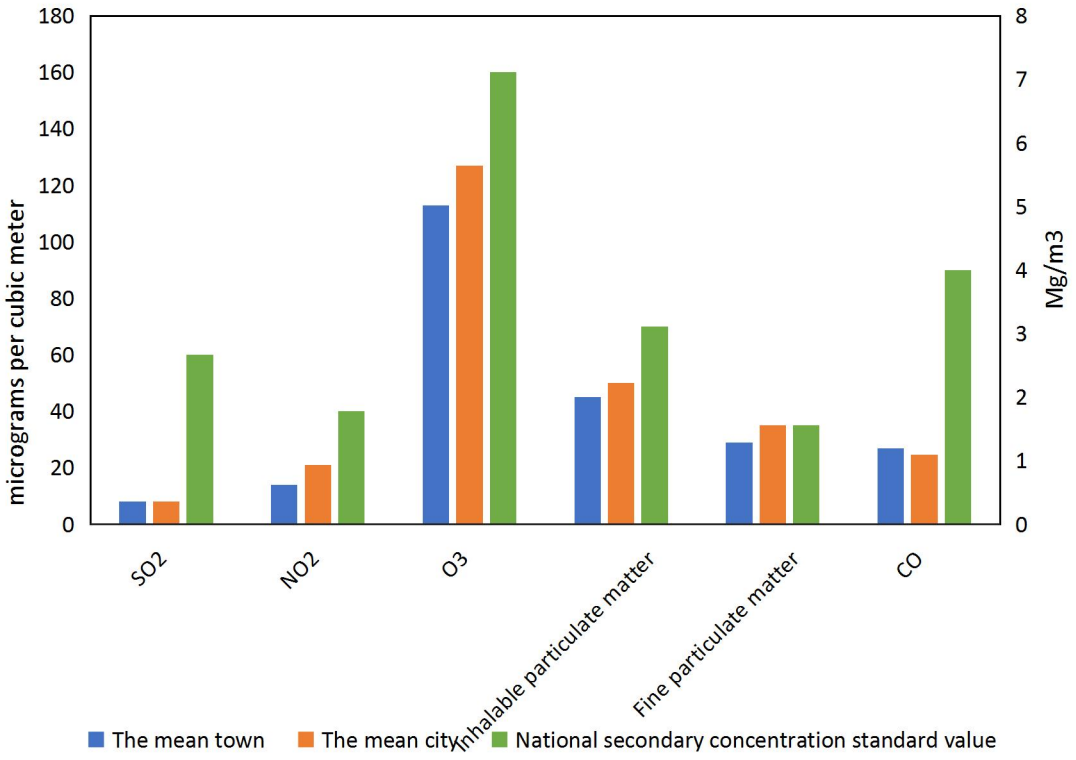

Fig. 3 Ambient air quality pollutant concentrations in 90 county-level cities and towns in 2019

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5. Monthly average pollutant concentration changes

Figure 4-4 shows the monthly mean concentrations of main pollutants in ambient air of 90 county-level cities and towns. As can be seen from the figure, the annual concentration of sulfur dioxide is low and relatively average. Nitrogen dioxide, inhalable particulate matter, carbon monoxide and fine particulate matter all had relatively low concentrations from April to October; January, February, November and December were four months with heavy pollution. Fine particulate matter exceeded the second-level national standard value in January, February and December, and fine particulate matter exceeded the second-level national standard value in January. Ozone concentration was lower in January, February, March, April, November and December, and highest in June and September.

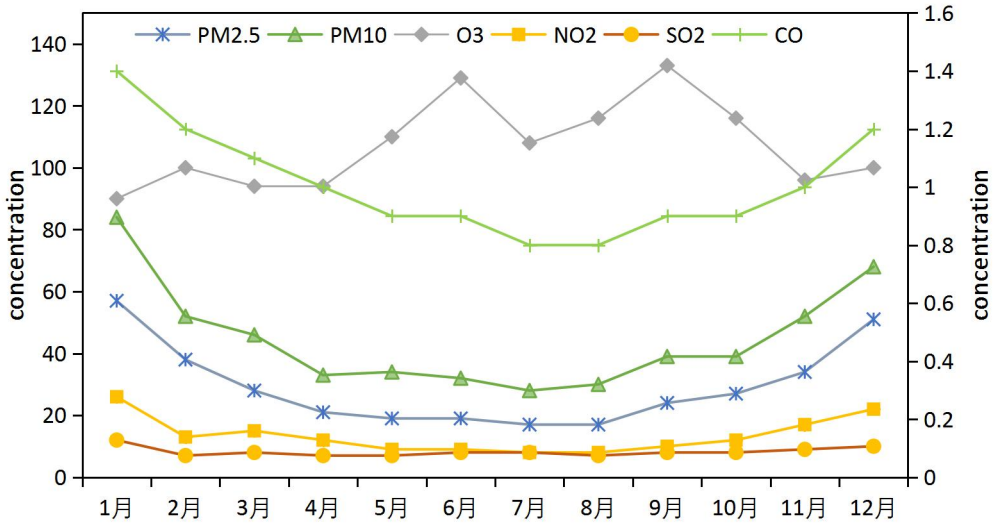

Fig. 4 Monthly mean value changes of main ambient air pollutants in county-level cities in 2021

6. The conclusion

In the process of analyzing and studying the air pollution situation caused by meteorological factors in Hunan Province, researchers can find that by comparing the basic information such as temperature, illumination and humidity: Since the promulgation of relevant environmental protection laws and regulations, the air quality data of Hunan province has gradually improved. The concentrations of sulfur dioxide, nitrogen dioxide, carbon monoxide and PM10 have been in the second-level standards, and the air quality is good. PM2.5 concentration is decreasing, but ozone concentration is increasing. The main factors affecting ozone concentration are air temperature and sunshine duration. The higher the air temperature is, the higher the ozone concentration is. Therefore, researchers can only control the ozone concentration in Hunan province through appropriate cooling methods.

To sum up, in hunan province overall air quality improved obviously, the local government in order to effectively control the air pollution situation, through the help of external force, to reduce the temperature in hunan province, increase the humidity in the air, build a blue, clear skies for the local, for local residents to create a comfortable and safe living environment, a hand to improve the local ecological environment.

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